



**Objective**

# Audio Quality

**Measurement**

**NTIA Institute for Telecommunication Sciences**

## Highlights

- Reliable Estimates of Perceived Audio Quality are Produced in Real-Time
- Developed and Implemented using DSP Techniques
- Technique under Consideration for ANSI Standardization
- Measurements have High Correlation with Subjective Test Results

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Audio Quality Experiment Control Station  
ITS Audio Quality Laboratory

## Digital Audio Compression

With technologies for digital audio encoding, compression, and transmission becoming more and more diverse, there is a growing need for objective audio quality measures that correlate well with human perception. Existing and proposed systems for transmitting audio over digital networks now include 4 kHz speech systems, with bit rates ranging from 1.2-64 kbps; 7 kHz speech systems, with bit rates from 16-64 kbps; and 20 kHz multichannel audio systems, with bit rates from 64-128 kbps per channel. These dynamic, non-linear systems generally do not encode waveforms, but instead represent audio signals by their frequency content or other characteristics. Not surprisingly, traditional waveform reproduction measures are usually ineffective in assessing the listener-perceived quality of these digital audio systems.

## ITS Audio Quality Measurement

The ITS Audio Quality Project addresses this situation by developing practical digital signal processing algorithms that objectively estimate perceived audio quality. These algorithms feature simple yet effective perceptual transformations that model important attributes of human hearing. Perceptually transformed audio signals are then compared using distance measures that seek to model the significant aspects of auditory judgment. The resulting estimates have been found to correlate well with over 10,000 listener judgments, made on 182 different 4 kHz bandwidth compressed digital speech systems, with bit rates between 2.4 and 64 kbps. The algorithms are under consideration for ANSI standardization and patent protection. ITS audio quality measurement technology performs so well that, in the near future, it will be incorporated into a commercially available product that will find application in the cellular telephone industry. In addition, ITS has developed a real-time PC implementation of one algorithm that demonstrates the practicality and utility of the work and provides a vehicle for efficiently performing laboratory and field measurements.